



November 21, 1979

Mrs. Ruth Clusen
Assistant Secretary for Environment
Department of Energy
Washington, D.C. 20545

US DOE ARCHIVES	
RG	326 U.S. ATOMIC ENERGY COMMISSION
Collection	1320
Box	16 - Palomares
Folder	25 - Review Comments

Dear Ruth:

The preliminary working draft of a Proposal for Accelerated Efforts Related to Project Indalo prepared by Drs. C. R. Richmond, B. W. Wachholz and P. N. Dean has been reviewed by an ad hoc advisory group listed on Attachment 1.

The Proposal was directed to a four-point follow-up program described in the Hall-Otero agreement of 1966 between the U.S. Atomic Energy Commission and the Spanish Junta de Energia Nuclear (JEN). The following comments are addressed to the work proposed for these four areas, which includes several new activities and to the program in general.

The Advisory Group's assessment of the current status of Project Indalo:

1. An adequate assessment of Pu levels in the environment apparently was not performed at Palomares either immediately after cleanup or since then; nor has an integrated assessment of Pu levels in the environment and in the residents been documented.
2. The AEC/ERDA/DOE has not developed an adequate institutional plan, as the responsible U.S. agency, for providing a continuous dose assessment for the population of Palomares.
3. In carrying out the plan described in the Hall-Otero agreement the Spanish government obtained a considerable amount of data and accumulated a large backlog of samples for radioanalysis.
4. Since the initial decontamination of Palomares, U.S. input has been largely limited to providing technical assistance as contrasted to an integrated (Spanish-U.S.) research or assessment effort.
5. There does not exist in one location an adequate institutional record of the activities at Palomares since the cleanup.

Because of the political and scientific importance of Project Indalo, a major effort to improve the administrative and technical aspects of the project is justified. To obtain these objectives, the following are recommended:

1. Responsibility for the handling of all Palomares activities should be clearly assigned to an individual within the Department of Energy to assure that U.S. government responsibilities are met on a continuing basis.
2. A clearer understanding should be obtained of the Spanish government's objectives and plans for activities relative to Palomares.
3. Based on objectives defined by the Spanish, a plan for the United States' role in achieving the objectives should be developed as soon as possible. The present proposal is a start.
4. Everything that has taken place relative to Palomares beginning with the clean-up and continuing up to the present should be documented and compiled in one location in the U.S.
5. In conjunction with the Spanish authorities, identify or reaffirm existing technical interfaces between the Spanish government personnel and U.S. personnel. This technical advisory group should be comprised of appropriate expertise adequate to develop an effective program and to assess the manner in which it is performed.
6. A principal investigator should be identified and funded to assume responsibility for working closely with his Spanish counterpart to carry out the program developed by the technical advisory group, including planning appropriate projects and protocols, interpreting data, secure needed technical support and preparing annual reports.
7. The technical advisory group should review and approve projects and protocols prior to their initiation, assure quality of the data and review reports prior to release. **DOE ARCHIVES**
8. The highest priority should be accorded development of a detailed dose assessment for the population of Palomares to determine whether clinical, epidemiological and radiological studies are warranted. A necessary first step of this dose assessment is a radiological resurvey of the relevant Palomares area.

Specific comments on four points of follow-up program addressed in the proposal:

1. Collection of information on the uptake and retention of plutonium and uranium by representative members of the population group who were potentially exposed to plutonium oxide by inhalation.

The draft "Proposal for Accelerated Efforts" proposes health effects studies in addition to collection of information on the body burdens of plutonium and uranium in the population. Although it is recognized that the health of the residents is of primary concern to the JEN, until there is evidence of plutonium and uranium uptake and retention in the Palomares population the medical follow-up emphasized in the expanded program is premature. It is suggested the study be divided in two parts:

- a) a study of uptake and retention as manifested by representative members of population groups potentially exposed, coordinated with a dose assessment based on levels of plutonium and uranium measured in air, water and foodstuffs, and
- b) the development of plans for a study of possible health effects, to be conducted only if justified by the results of the dose assessment.

2. Measurement of the temporal and seasonal fluctuations in the plutonium-oxide contaminated agricultural area that was subjected to the decontamination procedures following the accident.

An inventory should be established of all existing air samples by collection location and time and by the likelihood that the collection methodology yielded a valid sample. Priorities for radiochemical analysis can then be established. A long-term strategy for air sampling should be established that includes provision for collection and storage of a relatively large number of samples with timely analysis of a relatively few representative samples.

DOE ARCHIVES

3. Serial measurements of contamination levels (both by plant uptake from the soil and by wind dispersal) of agricultural products produced in the contaminated area subsequent to decontamination.

Existing data on soil and agricultural product content of Pu should be critically reviewed and an inventory established of samples already on hand. Existing data should be used in a preliminary assessment of agricultural products contamination.

A strategy should be developed for future sampling and analyses to determine levels of Pu in foodstuffs sent to the marketplace,

November 16, 1979

and to gain improved knowledge of the inter-relationships between air-soil-water and plant concentrations of Pu.

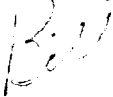
4. Studies of the temporal migration and redistribution of plutonium oxide in soil, which has been decontaminated by deep plowing, as a result of continual cultivation and weathering processes.

Existing soil analysis data and soil samples available for analysis should be reviewed to determine if analytical data are already available or can be obtained that will provide information on the temporal migration and redistribution of Pu in soil as affected by agricultural practices and weathering. If additional data are required, a plan should be developed for collection of a few selected representative or indicator samples from areas being subjected to different types of agricultural use.

5. It is recognized that implementation of these recommendations may require a significant increase in level of funding.

The reviewers will be pleased to discuss these comments with you or with Dr. Wachholz.

Sincerely yours,



W. J. Bair, Ph.D.
Manager
Environment, Health and
Safety Research Program

DOE ARCHIVES

WJB:ms

Attachment

cc: Northern Marshall Islands Advisory Group

REVIEWERS

Attachment 1

Dr. John A. Auxier
Health Physics Division
Oak Ridge National Laboratory
Oak Ridge, TN 37830

Dr. William J. Bair
Battelle
Pacific Northwest Laboratory
Battelle Boulevard
Richland, WA 99352

Dr. Chester W. Francis
Oak Ridge National Laboratory
Post Office Box X
Oak Ridge, TN 37830

Dr. Richard O. Gilbert
Battelle
Pacific Northwest Laboratory
Battelle Boulevard
Richland, WA 99352

Mr. John W. Healy
Health Division
Los Alamos Scientific Laboratory
P.O. Box 1663
Los Alamos, NM 87545

Dr. Roger O. McClellan
Inhalation Toxicology
Research Institute
Lovelace Foundation
P.O. Box 5890
Albuquerque, NM 87115

Dr. Strother H. Walker
University of Colorado
Medical Center
4200 East Ninth Avenue
Denver, Colorado 80262

Dr. William L. Templeton
Battelle
Pacific Northwest Laboratory
Battelle Boulevard
Richland, WA 99352

Dr. Roy C. Thompson
Battelle
Pacific Northwest Laboratory
Battelle Boulevard
Richland, WA 99352

DOE ARCHIVES

Specific Comments for Use by the Authors of the Proposal

1. Collection of information on the uptake and retention of plutonium and uranium by representative members of the population group who were potentially exposed to plutonium oxide by inhalation.

The draft "Proposal for Accelerated Efforts" proposes health effects studies in addition to collection of information on the body burdens of plutonium and uranium in the population. Although it is recognized that the health of the residents is of primary concern to the JEN, until there is evidence of plutonium and uranium uptake and retention in the Palomares population the medical follow-up emphasized in the expanded program is premature.

The proposal is solidly based on the background and long-term realities of the situation. The following recommendations are for a series of minor adjustments or improvements rather than any fundamental change. It is suggested the study be divided in two parts, as follows:

- a) a study of uptake and retention as manifested by representative members of population groups potentially exposed coordinated with a dose assessment based on levels of plutonium and uranium measured in air, water and foodstuffs;
- b) a study of health effects in two phases:
 - (1) a planning study to start now;
 - (2) an actual investigation to start only if significant levels are established in part (a).

The proposal, while not entirely in accord with standard epidemiologic methodology, is well adjusted to the actual conditions in which the field work must be done. Hence the plan can be built upon with the development of a complete, stratified sampling list before field work starts. This sampling list of the affected population will systematize all existing information about such factors as age, sex, location of residence, occupation and potential exposure. One advantage in this particular case is that this listing can make full use of the other elements of study, e.g., ground area survey, animal sampling and particle-size determination, together with the earlier work in these areas. **DOE ARCHIVES**

The function of such a sampling list is to provide the necessary basis for design and implementation of an optimal stratified random sample for accurate determination of uptake and retention. The intent is to follow the main outline of the proposal requiring annual measurement of levels in small samples of approximately six subgroups of the population; once the list is complete, a statistician on the JEN staff could readily design this sample. Subgroup samples would not turn out to be exactly 10, but can be kept small while still

satisfying objectives. The most difficult element here is sampling randomly in the field, but this is worth insisting upon because of the scientific value of determinations made in this way.

In selecting the final subgroup sample sizes the statistician involved will need prior data on measurement variability and should be encouraged to apply U.S. results such as those of Moss et al. (1969)*.

The tests that should be made over the next year or two, on as many people as possible, in order of probable value, are:

- a) analysis of fecal samples from persons suspected of being exposed,
- b) analysis of urine samples from anyone exposed,
- c) lung counts on anyone identified as having been exposed,
- d) autopsy samples from the population.

Any positive results should be confirmed as soon as possible under circumstances that would preclude repetition of error.

It should be clear that the objective is only to determine whether individuals in the population have detectable body burdens of plutonium.

There are several difficulties, inherent in the situation, which the planning phase is designed to meet. Epidemiologic methodology for study of chronic disease has developed quite rapidly since 1950 in England, the U.S. and a few other countries (e.g., Japan). Such methods have not been pursued in the location of interest, however. And in addition, the specific conditions of this study are not well suited to epidemiologic field work.

DOE ARCHIVES

Interest in the health of residents and in "monitoring" can lead to the sort of anecdotal medical records well known to result in serious bias, which can be dangerously misleading. By focussing substantial energy and attention, and some funds, on planning a modern epidemiologic survey, these anecdotal collections can be either avoided or counterbalanced

An example concerns choice of controls for a health study (the control group in the proposal is adequate for a study of contamination levels) which can begin in the planning phase. Step one is the choice of a "matched" or comparable community. Step two is recording of mortality in the two communities. Here the point is to be emphasized to the Spanish scientist, that ascertainment of mortality must be identical to the exposed and control communities. That is, extra health care activities in the affected community, which might lead to finding deaths not otherwise recorded, must be balanced in the control community, or discounted.

*Moss, W. D. et al. (1969). Health Physics 17, 571-8

The sampling above would provide the basis for any health studies that might be indicated by the dose assessment.

2. Measurement of the temporal and seasonal fluctuations in the plutonium-oxide-contaminated agricultural area that was subjected to the decontamination procedures following the accident.

An inventory should be established of all existing air samples by collection location and time and the likelihood that the collection methodology yielded a valid sample. With this inventory in hand a strategy can be established as to the priority to be accorded radioanalysis of the samples. Consideration of the results of analyses already performed, climatological factors, land use by year and other factors should allow a year to be identified as being representative. Samples collected during this representative year should be given first priority for analyses. Further, it should be possible to establish which samples (on a longitudinal basis) would provide a profile of air concentrations as a function of time since 1966. Concurrent with the above activities the air sampling equipment and procedures currently being used should be critically reviewed to determine if changes are required. A long-term strategy for air sampling should be established. It is recommended that this include provision for collection and storage of relatively few representative or indicator samples.

The air sampling station at 2-1 should be reestablished and the other stations reconditioned. However, the air sampling stations will not be adequate to completely measure "possible movement of material from the untreated hillsides" because only a small fraction of the soil (and associated plutonium) is resuspended into the air. The majority of the local movement is probably by surface creep or saltation or by movement as sediments in rain-swollen streams.

In addition to collection of air samples at fixed locations, the Spanish should be encouraged to conduct a few carefully designed studies to establish the air concentrations of Pu encountered by the local citizens in carrying out their daily activities. This should improve the quality of the estimates of the exposures of the population.

DOE ARCHIVES

Particle size distribution studies are proposed. The highest levels of plutonium that have been seen to date are a few hundredths to tenths of a femtocurie per cubic meter. Therefore, it is not feasible to determine particle size distributions in the usual manner, i.e., impactor and radioactive counting. It would require on the order of a thousand cubic meters of air or more through a relatively small set of orifices in order to make a meaningful determination. But, under these conditions, the dust loading would preclude alpha energy determinations and the natural radioactivity in the area may preclude the use of gross alpha counting. However,

if a means can be found to measure this size distribution (including the soil particle associated with the plutonium) the information would be exceedingly useful. The above does not relate in any way to soil particle size distributions, independent of plutonium, that might be made using the electron microscope or other means.

3. Serial measurements of contamination levels (both by plant uptake from the soil and by wind dispersal) of agricultural products produced in the contaminated area subsequent to decontamination.

Existing data on soil and agricultural product content of Pu should be critically reviewed and an inventory established of samples already on hand. This should be done to learn as much as possible from the existing data and to determine which of those samples already available would be most profitably analyzed. An individual knowledgeable in agricultural practices in Palomares should participate in the review.

A strategy should be developed for any future sampling and analyses. This should recognize that two types of information might be obtained; a) levels of Pu in foodstuffs sent to the marketplace, and b) improved knowledge of the inter-relationships between air-soil-water and plant concentrations of Pu.

Analysis of this type of data should have a high priority since it will establish the potential contributions of foodstuff as a source of Pu to people. Samples selected for analysis should reflect local agricultural, marketing and food preparation habits. For example, if tomatoes are eaten raw without washing and with the skin intact, then intact, unwashed tomatoes should be analyzed.

4. Studies of the temporal migration and redistribution of plutonium oxide in soil, which has been decontaminated by deep plowing, as a result of continual cultivation and weathering processes.

Existing soil analysis data should be reviewed to determine if analytical data are already available or can be readily obtained that will provide information on the temporal migration and redistribution of Pu in soil as affected by agricultural practices and weathering. A scientist knowledgeable about agricultural practices at Palomares should be involved.

DOE ARCHIVES

The existing soil sampling protocol should be reviewed to determine whether soil samples will be adequate for following temporal migration and redistribution of Pu in the soil. A strategy should be established for future analytical activities (because of their time-consuming nature), concentrating on timely analysis of a few selected representative or indicator samples from areas subjected to different types of agricultural use. Because of the relatively slow rate of Pu redistribution, the analytical schedule established may well emphasize samples collected at longer intervals than one year.

The research plan calls for a resurvey of the soil throughout Area 2 with spot checks in and around Palomares. This should be done as completely as possible to provide a basis for future studies of migration and for estimating the exposure of people in the area. Also, greenhouse studies such as those done shortly after the event should be repeated to determine whether the availability of plutonium for uptake by plants has increased with time.

It is very important that a detailed field instrument survey be conducted to document the present spatial distribution of Pu and Am concentrations. The draft proposal is quite correct in stressing the need for such a survey, especially since the only previous field survey was conducted before the cleanup operation was conducted. The design of the survey should be carefully planned. Some considerations are:

- (a) Some type of grid must be established for taking the proposed phoswich survey readings so that these data can be accurately placed on a map of the area. The setting of corner stakes and the use of a tape measure to establish sampling locations may be required rather than pacing. This survey will probably need to be repeated a few years from now to check on possible redistribution of Pu and Am. Hence, phoswich locations for the present survey must be well established and proper records maintained. The location coordinates of each phoswich reading should be recorded. Other variables such as soil condition (plowed, presence or absence of crops, rocky soil, river bed, etc.) should also be recorded.
- (b) It seems prudent to perform some limited field trials with the phoswich detector at Palomares to test its precision before conducting the main survey. These pilot studies could be done rapidly in the field with little expense.

DOE ARCHIVES

Attempts should be made to correlate phoswich readings with radionuclide concentrations as obtained from soil samples collected at phoswich reading locations. This relationship will depend on the height that the phoswich is held above ground surface, so this height must be established and not be allowed to vary between locations. If the correlation between phoswich and surface soil is sufficiently good, then statistical techniques such as double sampling might be used to estimate soil concentrations using phoswich measurements in combination with a limited number of soil radiochemistry data.

Also, if the Pu to Am ratio is constant throughout the Palomares area, the number of Pu analyses could be reduced if Am concentrations were obtained for all samples. This could result in cost reductions since Am can be determined more economically than Pu.

The use of Kriging (a statistical estimation technique) for estimating the spatial distributions of radionuclides in surface soil at Palomares should be considered. Kriging could possibly be used on the phoswich grid readings to obtain average surface soil concentrations

within units of land (e.g., 10 x 10 or 100 x 100 meter blocks) as was done on the Enewetak Atoll in connection with the radiological cleanup effort. Estimates of error for these averages can also be obtained using Kriging.

The size of soil aliquots being used for Pu radiochemical determinations should be carefully considered. Due to the possible particulate nature of the Pu in Palomares soil, aliquots of at least 10 g should be used. Based on experience at the Nevada Test Site where particulate Pu is also present, 50 g or larger aliquots may be preferred. The optimum aliquot size could perhaps be determined from a special soil sampling study where Pu or Am analyses are conducted on a number of aliquots of different sizes. A similar study has been performed on Nevada Test Site soil by the Nevada Applied Ecology Group.

DOE ARCHIVES

The draft proposal indicates (p. 23) that the Spanish have begun measuring Pu in the upper millimeter or so of soil. This very small cut of surface soil raises questions about the reproducibility of such sampling techniques. Presumably this fine cut is used to obtain the fine dust or soil on ground surface that might be most readily inhaled. The value of such samples should be reviewed. The depth below the surface from which samples are collected will strongly influence the observed Pu concentrations. Consistent and applicable techniques should be agreed upon to assure that data collected now can be compared, with confidence, to data collected several years from now.